The Province of Alberta

IN THE MATTER OF "THE NATURAL GAS UTILITIES ACT"

—and—

IN THE MATTER OF an Enquiry into Scheme to be adopted for Gathering, Processing and Transmission of Natural Gas in Turner Valley

---

G. M. BLACKSTOCK, Esq., K.C., ***Chairman***

Dr. E. H. BOOMER, F.C.I.C., ***Commissioner***

Session:

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April 4th, 1945,
9.30 A. M.

S. E. Slipper,
Cross-Exam. by Mr. Chambers.

CROSS-EXAMINED BY MR. CHAMBERS:

Q Mr. Slipper, in your evidence-in-chief yesterday at Page 1391 of Volume 17 of the transcript, you told us, and I quote your words, "In this connection of course we know that there are very large reserves already developed in the Viking-Kinsella field which are now supplying the Edmonton gas system. The reserves in those two fields are 600 billion cubic feet. This amount could be added to very materially by further development." Would you please describe to me the limits of those two fields, that is geographically?

A By Township and Ranges?

Q Yes. Have you that information?

A I can use the map without putting it in?

Q Surely, and by the way, are there two fields or one?

A They are classified as two. I will describe the boundaries of the Viking field first. Its southern boundary is approximately the south Township line of Township 48. Its north boundary is approximately the north boundary of Township 49. Its west boundary is approximately the west boundary of Section 3, in Township 48, to the west boundary of Section 34 in Township 49.

Q That is the Viking field?

A I have not finished yet, sir.

Q Pardon me.

A The east boundary is approximately from the east boundary of -. May I go back to the description of the west boundary and state that that was in Range 13. The east boundary is in Range 12 from the west boundary of Section 33 southward to the west boundary of Section 3 of Township 48, and that is in Range 12. The Kinsella field boundary; the south boundary is approximately

the south boundary of Township 47. The north boundary is approximately the third tier of sections upward in Township 49. The west boundary is approximately the range line between Ranges 11 and 12, and the east boundary is in Range 10 and is approximately from the east boundary of Section 33, Township 49 southward to the east boundary of Section 3, Township 47. All this is west of the 4th Meridian. Now there are some additional acreage in the Kinsella field that will extend southward from the block mentioned which amounts to about 15 sections. It has an irregular boundary that would be difficult to describe.

Q Thanks Mr. Slipper. Now those areas that you have just given us, do I understand correctly that those are the proven areas that have this 600 billion?

A Yes sir.

Q And that when you spoke of at Page 1391, in reference to the 600 billion cubic figure, you say this amount can be added to very materially by further development. Do you refer to further development in the area you have given us or -

A No. Extensions.

Q Extensions of those areas?

A Yes.

Q Do you know offhand or can you give us roughly the acreage in those two areas you have given us?

A There is about 200 square miles.

Q Altogether?

A Yes.

Q Now could you give us some idea of the basis or manner in which you arrived at your computation or estimate of 600 billion?

A Yes sir. Of course it extends over several years of data. The method that I use depends upon drawing pressure contour maps

from year to year and then from these developing a set of pressure convergence maps from which I get information in respect to the area over which migration takes place. From that I can project pressure drops beyond the area of the wells that our data is obtained from. Then, of course, I use the usual principle of decline production against pressure decline, drawing curves, and that production is weighted over the area on which I have my pressure drop as developed from my convergence maps and in that way I can fairly well control the area from which I have taken the gas and by extrapolating backward find out how much gas was originally there, subtract that from the amount we have taken out and it leaves the remainder, as the reserve.

Q In computing your estimates down to what pressure did you compute the wells for the purpose of this 600 billion?

A The usual pressure at Viking and Kinsella which is considered a base pressure is 200 pounds, but in this case I have not used; that figure 600 billion cubic feet, is down to zero pressure over the area in which I allot the reserves, but the reason for that is that I know there is gas coming in from large areas beyond that 200 square miles which is replenishing the field and that I am, I think, justified in taking it to zero pressure on that account.

Q Assuming that this area that you have given us which I will call the proven area.

A Yes.

Q Assuming that is the only gas area?

A Yes.

Q And not take into consideration any influence of outside reserves, would you still arrive at that figure of 600 billion?

A No. You mean if I refused to consider the fact that there is

gas coming into the field?

Q Yes, and if you compute down to say abandonment pressure of 100 pounds per well, you would get a considerably less figure than 600 billion?

A Yes. I do not know how much but probably 500 billion.

Q Now direct your attention particularly to the Viking field.

A Yes sir.

Q As I understand it there has been 26 wells drilled in that area?

A That is about it I guess.

Q And 18 of them are producing now?

A Yes.

Q And 7 of them have been abandoned in the past and one was a dry hole?

A That is right. Of course the abandonment was not because they ran out of gas. They were abandoned because they were defective wells. There is only one well, No. 21, in any of that area which has been announced a non-producer.

Q I would like to get some idea of the spacing of these 26 wells without going into all the details of the exact location of each. I wonder if you could give us that.

A Yes, the spacing at Viking has been a change from time to time. Originally they started out feeling out for the field. Some wells were very widely spaced. For instance No. 9 was away north of where No. 1 was, 10 miles probably. No. 10 was 6 miles east and so on, and later they commenced filling in between and the spacing is irregular at Viking, and I should say that the average spacing is about half a mile, that is between wells.

Q The total area of the two fields you told me is around 200 square miles?

A Yes.

Q And roughly how much of that would be in the Viking area?

A One-third.

Q And those 26 wells you told me are scattered around so as to be representative of the area?

A Yes.

Q What is the average thickness of the gas sand in the Viking area?

A The average thickness of the gas sand in the Viking area is about 14 feet.

Q And have you made, and you have, I take it, an estimate of the average porosity of that area?

A I should say it is about 25%. Now that is not measured.

Q And what was the original rock pressure there?

A 750 pounds.

Q DR. BOOMER: By the rock pressure you mean top of the hole?

A Yes, that is the original top hole pressure.

Q MR. CHAMBERS: Can you give us some idea when these 26 wells were drilled, when did they start?

A No. 1 was drilled in 1916, no, 1914, and the last well drilled was No. 24, in 1932 or '33. I would much prefer to find this out rather than put it on the record as guesses.

Q What I am getting at is this, you spoke of the first one drilled in 1914, were there several of them drilled at that time, a block of them?

A No, the first well was drilled by a group of citizens in Edmonton, I forget the name of the group, I do not think

it was syndicate, and it stood idle for a very long time; in 1924 there had been 11 wells drilled and at that time the pipeline was constructed from Edmonton to Viking.

Q By1924 was it?

A Yes, by 1924.

MR. STEER: '23 was it not?

A Yes, '23.

Q MR.CHAMBERS: And it had 11 wells drilled down to '23?

A Yes.

Q Let us take it from '23 to '30, for instance, were there some more drilled then?

A Yes.

Q Has there been any recent drilling there?

A Not at Viking.

Q Not at Viking?

A No.

Q I understend that the position of the Viking field, the gas production was approximately 75 billion up to the end of last year, is that right, or have you got that figure in mind?

A It might have been, yes.

Q Now, turning to the Kinsella field?

A. Yes sir, the Kinsella.

Q I understand that there have been 19 wells drilled there?

A Yes, that is right.

Q And that 17 of them were producers.

A Well they were all producers but No. 9 was a small well compared to the others. No. 9 is only a 2 million foot well while the average volume of the others is 15 million.

Q There are 17 of them producing now?

A Yes, there are 17 of them producing now.

Q Can you give us a general outline when those wells were drilled?

A They have been drilled - I have not got the dates, I am sorry.

Q Can you tell us when the first one was drilled?

A I could not tell you when the first one was drilled, no sir.

Q I see. And what would you consider is the average thickness of the gas producing sand in the Kinsella field?

A About 10 feet.

Q About 10 feet?

A Yes.

Q And have you made an estimate of the porosity there?

A No, I have not. It has a much better porosity than at Viking but I cannot give any definite figure.

Q Now for the purpose of your estimate, did you make any segregation of the 600 billion as between Viking and Kinsella?

A No, it was an estimate of the whole area.

Q Now, as I understand it, the gas in those fields would have to be dehydrated, would it not?

A So far, no, there has been no dehydration.

Q There has not?

A No.

Q Thanks.

THE CHAIRMAN: Mr. Harvie?

MR.HARVIE: No questions.

THE CHAIRMAN: Mr. McDonald?

MR. McDONALD: No questions.

THE CHAIRMAN: Mr. Blanchard?

MR. BLANCHARD: No questions.

THE CHAIRMAN: Thanks very much, Mr. Slipper. Have you any evidence to lead, Mr. McLaws, on this phase of the matter?

MR. McLAWS: Yes, sir. I will have my man here in a few minutes, I just 'phoned him.

THE CHAIRMAN: Have you anything further, Mr. Chambers?

MR. CHAMBERS: I am going to call a witness that I did not intend to call, except that this 600 billion figure has been mentioned and Mr.Webb is here, so shall I call him now or after?

THE CHAIRMAN: Now will be all right.

.....

JOHN BENWELL WEBB, having first been duly sworn, examined by Mr. Chambers, testified as follows:-

Q MR. CHAMBERS: Mr. Webb, I understand you are the district geologist for Imperial Oil Limited?

A I beg your pardon?

Q You are the district geologist for Imperial Oil Limited? Do not nod your head, just say yes. The reporter cannot take it down.

A Yes, that is correct.

Q Now for the purposes of the record it is necessary for me to go and get a short biography of your education and qualifications. As I understand it, you graduated from the University of Manitoba in 1925?

A That is right.

Q With what degree?

A B.Sc. in Geology.

Q And you undertook certain post-graduate work?

A I took a Master of Science degree.

Q What University?

A At the University of Manitoba.

Q And you received your Master of Science degree in 1930, is that right?

A Yes.

Q And what other post-graduate work did you take?

A I put in a half term at the University of Toronto, I did not complete the degree.

Q And from 1926 to '31, you were connected with the oil business where?

A In Calgary and Edmonton, with the Hudson's Bay Marland Oil Company.

Q And would you just outline briefly to us what your activities have been since, just in your own words? Where you have been engaged and the nature of your work?

A From 1932 to 1939, that is to mid-summer of 1939, I was employed in Eastern Canada, chiefly in metallurgic work. From mid-summer of 1939 until the mid-summer of 1944 I was employed by the Anglo-Canadian Oil Company in Calgary.

Q As a geologist?

A Yes. And since that time I have been with the Imperial Oil.

Q And you were in charge of the geological department here with them?

A Yes.

Q Now, Mr. Webb, you have prepared a report entitled "Gas Reserves of Southern Alberta"?

A That is true.

Q I tender that as an exhibit.

THE CHAIRMAN: Exhibit 57.

REPORT OF MR. WEBB, "GAS RESERVES OF SOUTHERN ALBERTA" MARKED EXHIBIT 57.

Q MR. CHAMBERS: Mr.Webb, would you read the report and make such comments as you see fit as you go along?

A Report on the Gas Reserves of SouthernAlberta.

SUMMARY AND CONCLUSIONS

For the purpose of this report we are not concerned woth the reserves of such old fields as Medicine Hat and lesser gas producing areas which are able to maintain only sufficient reserves to meet their respective local consumptions. Those fields and areas of particular importance or interest, with probable or possible gas reserves indicated, are listed below. The letter preceding each corresponds to the designation used on the accompanying map, Figure 1. That is in the envelope at the back.

Probable Reserves.

A. Viking - 75,160,000 Mcf.
B. Kinsella - 130,000,000 Mcf.
C. Foremost - 17,600,000 Mcf.
D. Bow Island - 13,000,000 Mcf.

Possible Reserves.

E. Viking-Kinsella Possible Extension - 100,000,000 Mcf.
F. Princess - 80,000,000 Mcf.

The following gas discoveries are at present undeveloped or indicated by only one or two wells, and it is impossible to estimate the reserves which might be proved by their further investigation. The number preceding each corresponds to its designation on the map.

Q That is on the map, Figure 1?

A Figure 1.

Prospective Area	Well	Initial Open Flow
1. Steveville	Anglo Steveville No.1	12,000 Mcf./day
2. Rainy Hills	Rainy Hills No. 1	7,000 Mcf./day
3. Pinhorn	Mayland Southern #1	11,600 Mcf./day (Cumulative)

That is f om several horizons.

4. Pinhorn East, or otherwise known as the Black Butte area,

	McColl-Frontenac 6-8-1-8	9,000 Mcf./day (cumulative)
	McColl-Frontenac 9-17-1-8	7,250 Mcf./day (cumulative)

5.	Dead Horse Coulee	Rogers Imperial No. 1	50,000 Mcf./day. (cumulative)
6.	Erickson Coulee	Northwest Erickson Coulee No. 1	10,000 Mcf./day (cumulative)

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Prospective Area	Well	Initial Open Flow
7. Eagle Butte	Eagle Butte No. 1	20,000 Mcf./day
8. Taber	Major Taber No. 1	6,000 Mcf./day
9. Jumping Pound	Shell 4-24-J	13,500 Mcf./day

INTRODUCTION

The object of this report is to review the situation with respect to probable and possible gas reserves in Alberta, apart from the Turner Valley field, which could be considered as sources of supply for the Calgary system in the immediate or distant future. It is worthy of note that since 1924, the year of the wet gas discovery in the Madison limestone at Turner Valley, discovery of sizeable commercial or potentially commercial gas fields has been limited to Kinsella and the Princess-Stevevillc areas, with the possible inclusion of the Pinhorn area. Other discoveries which are of doubtful, though possible, importance, are Erickson Coulee, Dead Horse Coulee, Eagle Butte and those located farther north such as Battleview-Vermilion, Duvernay and Athabaska. The recent discovery at Jumping Pound, although very little is now known of its extent, may indicate an important gas reserve. The old gas fields of the Southern Plains such as Medicine Hat, Bow Island, Foremost, Barnwell and Brooks and the Viking field farther north were all discovered in the period 1890-1916.

These facts regarding rate of discovery of gas reserves are of particular significance when we consider that prior to 1924 exploratory or wildcat footage drilled in Alberta (excluding footage drilled in known oil or gas fields) totalled approximately 300,000 feet. However, the wildcat footage drilled from 1924 to 1944 approximates three times this figure i.e. roughly 900,000 feet.

Q The footage you are referring to is the aggregate depth of all the wells that were drilled?

A Yes, sir.

VIKING GAS FIELD

Marginal letters or number refer to designation on accompanying map - Figure 1.

SUMMARY

The Viking Gas field is located in Townships 48 and 49, Ranges 12 and 13, W.4th Meridian, approximately 80 miles southeast of Edmonton and 175 miles northeast of Calgary on the main line of the Canadian National Railway. This field and the neighboring Kinsella gas field constitute the only source of supply for Edmonton and intervening towns. The productive area extends from a point two miles north of Viking for a distance of 9½ miles northwards, with a maximum width of 5 miles, the area regarded as proven territory including 34 square miles. The discovery was made in 1913 but active development of the field did not commence until 1923. Following are some of the pertinent data concerning the gas field:

Total number of wells drilled	- 26
Number of dry holes	- 1
Former producers now abandoned	- 7
Present number of producing wells	- 18
Reservoir rock - Viking sand (Upper Cretaceous)	
Average depth to gas sand	2150'
Average thickness of gas sand	16½'
Average porosity (estimated)	15%

Proven gas area - 34 square miles or 21,760 acres.

I might say that that figure is arrived at by using as the periphery of the proven area a line not

more than, well it may run from 1 to 1½ miles outside of the edge wells of the present producing field.

Well-spacing - generally one mile but in central part one-half mile.

Original rock pressure - 733 pounds per square inch.

Average 24 hour closed pressure November 1944 - 509 lbs. per square inch.

Average initial open flow per well - 5,921 Mcf. per day

Total production to December 31, 1944 - 55,390,560 Mcf.

Reserve Estimate - by pressure decline to 100 lbs. per square inch - 75,160,000 Mcf.

GEOLOGY

The gas accumulation occurs in the Viking sandstone, a marine sandstone member occurring in the Colorado (Alberta) shale about 140 feet above the top of the Lower Cretaceous. The sandstone is very fine grained, in part unconsolidated, averaging 16½ feet thick. The one dry hole drilled, Northwest Utilities No. 21, on the northeast margin of the field was due to complete absence of the sand at this location on the east margin of the field. The gas accumulation appears to be related to a southward plunging structural nose of minor relief lacking closure to the north. The regional dip in this area is west or southwest at ten to fifteen feet per mile. The local structure may be due to actual folding or to compaction of the Cretaceous strata overlying a buried Paleozoic limestone ridge.

It is noted that the larger initial flows were not necessarily associated with greater than average sand thicknesses. There are no cores available of the Viking sandstone from this field to my knowledge but it is probably very similar to this same member, as now well known from cores, at the

neighboring Kinsella gas field. At Kinsella the important factor appears to be the amount of clean unconsolidated sand, capable of acting as a good reservoir, which occurs as streaks or bands within the general sand zone.

Regionally, the Viking sandstone lenses out eastward and northeastward and this feature coupled with the southwest dip may provide a stratigraphic trap condition which has a bearing on the accumulations at Viking and Kinsella. However, with the evidence at hand from recent drilling in the search for oil in this sandstone down the dip to the south, southwest and west from the gas fields, it appears that the Viking sand is poorly developed as a reservoir in these directions, containing much argillaceous material, and the writer concludes the large gas accumulations must be due, in part at least, to the more favorable sand conditions in the Viking-Kinsella areas.

DEVELOPMENT

By the end of 1924 ten wells had been drilled by Northwest Utilities Limited and from then on until 1932 two to three wells per year were completed. Northwest Utilities Limited have, since 1932, developed the Kinsella field to the east, where the average gas flow per well is considerably better than at Viking. Hence no extension of the proven area at Viking has materialized, though favorable possibilities exist. Efforts are now being made to conserve the Viking field, maintaining pressure by shutting in the field for five months or more each year and using it merely to aid in carrying the peak load of the Edmonton demand during the winter months. The beneficial effect of this procedure is seen on the accompanying pressure decline curve which shows a slight increase in field pressure during the past two years.(Fig.2)

It is of particular interest that no edge-water has yet been found associated with the gas accumulations in the Viking sand at Viking and Kinsella. Again to my knowledge.

Q Would you mind turning to figure 2 and explain that last sentence to illustrate to we laymen what it is? Most of us are not familiar with these things.

A You will note that on both of these curves until late in 1941 the average field pressure, that is the figure plotted, shows a steady decrease. Since late in 1941 when the withdrawals from the Kinsella field commenced on a large scale the Viking field has been shut-in part time. That is to say in 1942 and you will see noted on the graph wells totally shut-in five months. In 1943 wells totally shut-in five months. In 1944 I have not the actual figure as to how long the wells were shut-in but judging by the production apparently there was about the same shut-in period. The result is that with the lower withdrawals from the field the pressure begins to rise, 'he pressure late in 1943 having risen to 492 pounds and in 1944 to 509 pounds. Naturally there is an equalization of the field pressure going on during the shut-in periods amd the actual pressures in the wells will rise.

Q Thanks.

RESERVES

(1) Pressure decline method

The accompanying Figure 2 also shows the pressure decline-cumulative production curve for the Viking field. The steady but moderate decline in pressure from the original 733 lbs./square inch in 1923 to 487 lbs./square inch in 1941 as indicated. This pressure drop of 246 lbs. yielded a total

production of 50,000,000 Mcf. of gas. If we estimate that the field will continue to be economically produced down to a pressure of 100 lbs./square inch, it is calculated that the remaining reserve of gas is 75,160,000 Mcf.

(2). Volumetric method

Using the volumetric method and assuming an average porosity of 15% for the gas sand, the original content of the reservoir within the 34 square miles of area is calculated to be 114,710,000 Mcf. Deducting from this figure the production to date of 55,390,660 Mcf. the reserve of gas remaining in the reservoir is then calculated to be 59,319,340 Mcf. It is pointed out, however, that under the present system of producing the field, drainage of gas is probably taking place from well beyond the margins of the prescribed proven area. It is, therefore, believed that the reserve estimate by the volumetric method is likely to prove too low in considering actual ultimate production from the field.

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"B" KINSELLA GAS FIELD

SUMMARY

The Kinsella gas field is located about ten miles south-east of the Viking field in Townships 47 and 48, Range 11, W.4th Meridian. The field extends northeast for about ten miles with a maximum width of five miles, the proven area (if extended to include Duluth Syndicate well) comprising 40.5 square miles.

I might say again that I took the field prescribed by the proven area as outlined by a line approximately one mile beyond the limit as indicated by the outside line of wells around the field. To include the Duluth Syndicate well I had to deviate slightly from that proceedure. The discovery of gas was made by the Duluth Syndicate No.I well in 1930, an initial flow of 21,000 Mcf. and closed pressure of 750 lbs per square inch being encountered. In 1932 Northwest Utilities Limited drilled their Kinsella Nos. 1 and 2 eight miles southwest of the discovery, obtaining good gas flows. Active development did not commence until 1941; since then fourteen more wells have been drilled by Northwest Utilities and two by Imperial Oil Limited and Hudson's Bay Oil and Gas Company Limited. The following field data are of particular interest:

Total number of wells drilled - 19
Number of dry holes - none
Present number of producers - 17
Reservoir rock - Viking sand (Upper Cretaceous)
Average depth to sand -2150'
Average thickness of sand - 9'
Average porosity (estimated) - 20%

Proven gas area - 40.5 square miles or 25,920 acres.
Well spacing - one mile or greater.
Original rock pressure -750 lbs per square inch.
Average 24 hour closed pressure October 1944 - 692 lbs per square inch.
Average initial open flow per well - 12,666 Mcf. per
Total production to December 31, 1944 - 14,258,142 Mcf.

Reserve Estimate -by pressure decline to 100 lbs per square inch - 130,000,000 Mcf.

GEOLOGY

The discussion of the general and local structure concerning the Viking field applies also to the Kinsella field. The Viking sandstone averages nine feet in thickness, considerably less than in the Viking field, but evidently it contains a higher percentage of porous sand (porosity estimated at 20%) which results in an average initial flow for this field twice as great as in the Viking field. The initial rock pressure of 750 lbs. per square inch agrees very closely with that at Viking and suggests that the reservoirs are inter-connected.

DEVELOPMENT

The discovery well, Duluth Syndicate No.I, drilled in 1929 and 1930, yielded the largest initial flow recorded, i.e. 20,600 Mcf. per day. This well is located at the northeast end of the proven area. It has never produced due to inability of the owners to dispose of the gas. Two wells were drilled by Northwest Utilities at the south end of the field in 1932 but pipe line connections with Viking were not made until 1940 and active development commenced in 1941. The field has now assumed the major part of the load in supplying the greatly increased consumption of gas by the Edmonton system. The consumption in 1940, supplied entirely by the Viking field, was 3,900,000 Mcf. whereas in 1944 the combined Kinsella and Viking output was 7,030,848 Mcf.

RESERVES

1. Pressure decline method

Reference to the pressure decline-cumulative production curve (Fig.3) indicates that from 1940 to 1944 the pressure dropped from 750 lbs. to 692 lbs. i.e. 58 lbs per square inch for a

gas production of 13,000,000 Mcf. Presuming that a pressure of 100 lbs per square inch may be the lower limit of economic operation, the reserve is calculated to be approximately 130,000,000 Mcf.

2. VOLUMETRIC METHOD

Using the volumetric method and assuming a porosity of 20%, remaining gas in the reservoir within the prescribed area is calculated to be 89,000,000 Mcf.

(E) POSSIBLE FIELD EXTENSIONS

There seems every possibility that the Kinsella field will prove to extend considerably beyond its present known area to the northeast, north and northwest.

I might also add that there seems to be no good reason why the Viking field cannot be extended on the northwest and the Kinsella field on the southeast. That might add to the possible reserves but we know that there are unfavourable sand developments for instance south eastward from Kinsella and the possibilities in that direction do not appear to be any too good. On the other hand you will note on the map that the area "E" shown as the area for possible development of reserves in the future includes the territory fairly solidly between the two proven fields.

On the east margin of the Viking field however there was one dry hole drilled, the sand being entirely lacking. That was Northwest Utilities No.21 I believe. Also on the east margin of the Kinsella field, northwest Kinsella No.9, was a very poor well, that is to say with a flow of only 2 million cubic feet per day and poor sand development was the reason for this rather poor development there. In general I think that the area of possible extensions of the Viking and Kinsella fields as shown on the map is reasonably generous. We know that northeast from the Kinsella field the sand pinches out entirely and northward from the Viking

field in the old Birch Lake area, the old Talpy-Arnold well had small gas flows, - nothing comparable to the commercial flows of the Viking or Kinsella fields. At the northeast end of the field, that is the Kinsella field, the Duluth Syndicate No.I well, with its high volume output, suggests good sand conditions continuing in that direction and every possibility that the field may extend for a matter of miles to the northeast and north. On the northwest side of the field the recently completed Imperial Hudson's Bay Kinsella No.I indicates good sand conditions continuing in that direction. It is quite possible that the area between the north end of the Kinsella field and the northeast side of the Viking field may ultimately prove to be continuously productive. It is readily seen that a possible productive area, at least equal in extent to the present Kinsella field, may ultimately be proven by further drilling. Such an extension to the proven territory would add another 100,000,000 Mcf. to the known reserves.

(C) FOREMOST FIELD

The Foremost gas field is located 160 miles southeast of Calgary in Townships 5 and 6, Ranges 10 and 11, W.4th Meridian. The discovery was made in 1916 and this field supplied the Calgary-Lethbridge system from 1923 until 1929. With the development of the Turner Valley gas supply, the Foremost field was closed-in late in 1929 and has since served only as a 'stand-by' supply for the Calgary system. The area regarded as proven is approximately one and three-quarter miles in width and six and one-half miles long, trending roughly north and south. The following data concern-the field are of interest:

Number of wells drilled - 9
Number od dry holes - 3
Number of gas producers - 6
Reservoir rock - Bow Island sandstone (Upper Cretaceous)
Average depth to gas sand -2200'
Average thickness of gas sand- 10'
Average porosity (estimated) - 20%

Proven gas area - 11½ square miles or 7,360 acres.
Well spacing - approximately one mile
Original rock pressure - 650 lbs per square inch.
Average 24 hour closed pressure, January 1945 - 584 lbs per square inch.
Total production to December 31, 1944 - 4,200,000 Mcf.

Reserve Estimate -by pressure decline method (to 100 lbs. per square inch) - 17,600,000 Mcf.

GEOLOGY

This field is located on the east flank of the Sweetgrass Arch, the dip of the strata in the producing area being about 30 feet per mile to the northeast. It is believed that the gas sand lenses out on the west side of the field, thus forming a stratigraphic trap for gas accumulation. The gas sand averages approximately 10 feet thick and is generally correlated with the Bow Island gas sand, one of the sandstone beds occurring in the Blackleaf member of the Colorado shale. In this area the sand is reported to be fairly coarse and unconsolidated providing a favorable reservoir rock.

DEVELOPMENT

Nine wells were drilled in the field, two of which were on the western margin where the sand became very thin and only minor gas flows were obtained. Another dry hole occurred on the down dip east side of the field where water occurred in the gas horizon. Initial open flows as high as 17,000 Mcf. per day were obtained.

RESERVES

1. Pressure decline method

During the period 1923-1930 the field produced in excess of 3,500,000 Mcf. of gas and the average pressure dropped from 650 pounds to 548 pounds per square inch. With this pressure decline as guidance, the expected production, down to a pressure

of 100 lbs. per square inch, would amount to approximately 17,000.000 Mcf. of gas.

2. Volumetric method

By volumetric method calculation, using an area of 7,360 acres, sand thickness of 10 feet and porosity of 20%, the original content of the reservoir is indicated to be 28,000,000 Mcf. Deducting from this figure the total production of 4,200,000 Mcf., the reserve indicated is 23,800.000 Mcf. The actual recoverable portion of this calculated reserve might range from 75% to 50% of this figure i.e. 18,000.000 to 12,000,000 Mcf.

POSSIBLE EXTENSIONS OF THE FIELD

Although the Foremost gas field has been fairly definitely delimited on the east and west sides, it would appear quite possible that further drilling northward and southward along the trend would yield some further extensions of the productive area.

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(D) BOW ISLAND FIELD

The Bow Island gas field is located approximately 145 miles southeast of Calgary in Townships 10 and 11, Ranges 11 and 12, W. 4th Meridian. The field was discovered in 1908 and in the course of its development 21 wells were drilled to the Bow Island gas sand at a depth of approximately 2,000 feet. A pipe line was constructed to Lethbridge and Calgary and the field supplied this system from 1912 to 1921. The original rock pressure of 745 lbs./square inch declined to 220 lbs./ square inch and many wells were flooded by incursion of edge water. Total production was 38,000,000 Mcf. Repressuring of the field with waste gas from Turner Valley was undertaken in 1930 and continued to 1939. A total of 13,822,934 Mcf. was pumped back into the depleted reservoir with the result that the closed pressure rose to 565 lbs./ square inch.

This gas reserve represents about one year's supply for the Calgary system but can be regarded as a reserve for possible use during peak load periods.

(F) PRINCESS-STEVEVILLE AREA

INTRODUCTION

This area is located 125 miles southeast of Calgary and includes Townships 19 and 21, Ranges 10 to 12, W. 4th Meridian. The structural features of the area are the Princess and Denhart folds which are northwest plunging structures with doubtful closure on the southeast flanks and are to be regarded as off-shoots of the main Sweetgrass Arch uplift. Large flows of gas have been struck at the following horizons in this area:

Formation	Age
1. Basal Colorado sandstone	Upper Cretaceous
2. Sunburst sandstone	Lower Cretaceous
3. Chert Bed	Jurassic ?
4. Madison limestone	Mississippian
5. Jefferson dolomite	Devonian

More information is available concerning the accumulation of gas (with accompanying oil and water) in the Sunburst sandstone and the directly underlying Chert Bed on the Princess structure than is known concerning the other horizons or other parts of the area. In the following discussion chief importance is attached to the possibilities of commercial production of gas at Princess although the Basal Colorado sandstone and Madison limestone are recognized as being worthy of exploration in certain localities to the north and east of Princess on the Denhart structure.

1. PRINCESS STRUCTURE

The Princess structure is located in Township 20, Range 12, W. 4th Meridian and the semi-proven gas productive area is five miles in length with a width varying from two miles at the southeast to one mile at the northwest end of the field. The discovery of gas on this structure was made in 1940 when the California Standard Company drilled their C. P. R. Princess No. 1 well and subsequently a total of nine wells have been drilled by this same company. Most of these wells, either by drill stem or production tests, have been indicated to possess commercial possibilities as gas producers from the Sunburst sandstone and Chert Bed, some of the wells yielding flows in excess of 10,000 Mcf. per day. All except one of the wells are believed to have encountered varying amounts of oil and salt water in the basal part of the sandstone or in the

Chert Bed. The known vertical range of gas and oil accumulation in the reservoir, i.e. from the highest elevation on the top of the gas zone to the edge water level is between 50 and 60 feet. The Anglo-Canadian No. 3 well, drilled off structure on the east flank, obtained an artesian flow of salt water in the Sunburst sand, indicating the active water drive in this field.

RESERVOIR BEDS

The Sunburst sandstone occurs at the base of the Blairmore formation, of Lower Cretaceous age, and is generally regarded as the basal member of the Cretaceous. The top of this sandstone is penetrated at depths between 3,150 and 3,200 feet and it averages about 30 feet in thickness. The sandstone is variable in character but is usually medium to coarse grained with a considerable chert content and frequently contains green shale partings. Very good porosity is developed locally but experience has shown that it is quite variable in this respect. The sand pinches out eastward and northwestward from Princess, grading into vari-colored sandy shales.

The Chert Bed, which is of questionable Jurassic age, occupies the interval between the Sunburst sandstone and the top of the Madison limestone, which is an eroded surface. At Princess the Chert Bed is generally 30 feet in thickness, but locally, where it fills in irregularities on the Madison surface it may be 65 to 70 feet thick. The Chert Bed consists of thinly interbedded green shale and coarse cherty sandstone lenses with angular chert fragments included, these fragments becoming larger and more abundant towards the base. Variable porosity is present in this zone chiefly due to many of the chert fragments being of a vuggy or fossiliferous character.

POSSIBLE RESERVE ESTIMATE

The semi-proven area may be estimated as 8½ square

miles or 5,440 acres. The average thickness of gas saturated beds in the nine wells at the Sunburst-Chert horizons is roughly estimated at 30 feet. Merely a guess may be attempted as to the average porosity of these beds but 10% is used herein realizing that it may be too high. Making use of these figures and one known bottom hole pressure of 1,640 pounds/square inch, a volumetric estimate of the gas reserve gives approximately 80,000,000 Mcf.

Since the gas and oil accumulation is under hydrostatic pressure and in view of the indicated areal and vertical limitstions of the accumulation, it can be assumed that water encroachment would present a production problem early in the life of the field if steady gas withdrawals occurred. The experience gained from the attempt to produce oil from the Sunburst sand on this structure supports this view. We can only guess at what percentage of the calculated reserve can be recovered but it would probably be safe to say that not more than 50%, i.e. 40,000,000 Mcf. should be considered as the actual recoverable reserve. If the Calgary system were entirely dependent upon this field for supply it is possible that the effects of peak load withdrawals of 85,000 Mcf. per day would have disastrous effects. In any case, the indicated available reserve of 40,000,000 Mcf. is only a three year supply for the Calgary system at the present rate of consumption. In its present stage of development therefore, the Princess field cannot be considered as a possible sole source of supply for Calgary. If further drilling should extend the gas area southeastward for an additional five miles and thereby possibly double the available supply, it would then constitute an important reserve. The chief hazard in connection with any prediction as to extension of the field is the possible discontinuity of

the Sunburst sand.

OTHER GAS HORIZONS AT PRINCESS

What would appear to constitute erratic, local gas accumulations have been found in the Paleozoic (Madison and Jefferson) formations. These discoveries are mentioned merely as a matter of general interest. They do not present any encouragement for future development.

(a) Madison Limestone

One well on the Princess structure, C. P. R. Princess No. 2, obtained gas and oil within the top 100 feet of the Madison limestone at 3225-3285'. It proved to be an erratic accumulation and water incursion followed the attempt to produce the oil. Other wells in the near vicinity, although encountering the limestone just as high structurally, failed to find either gas or oil, probably due to lack of porosity in these beds.

(b) Jefferson Dolomite

C. P. R. Princess No. 2 also indicated the possibility of a commercial gas accumulation in this formation, yielding approximately 6,000 Mcf. per day of dry gas in a drill stem test at 3900 to 3950'. Salt water was encountered immediately below the gas and presumably might cause difficulty if commercial development were undertaken.

A small amount of gas is produced with the oil being recovered from this formation, at the northwest end of the Princess field.

2. DENHART STRUCTURE

The Denhart structure lies parallel to and east of the Princess structure and includes the Rainy Hills and Steveville areas. Scattered wells have been drilled on this structure, the most interesting results being obtained in the

basal Colorado sandstone, the Chert Bed and the uppermost beds of the Madison limestone. These gas discoveries are of prospective interest only and no estimate can be attempted as to possible reserves represented.

(1) GAS IN BASAL COLORADO SANDSTONE

At Anglo Steveville No. 1 well located on the Red Deer River in Lsd. 2 of Section 13-21-12-W.4th and well down the plunge of the Denhart structure, gas was struck in this sandstone at 2,740-63 feet, a few feet above the top of the Blairmore formation. This sand was later tested by gun perforating the seven inch casing and a flow of 12,000 Mcf. per day was obtained, the gas carrying a slight naphtha and salt water content.

Showings of gas and oil were obtained in Anglo Steveville No. 2 well, 8 miles to the southeast, and Princess Steveville, (Syndicate) No. 2, one-half mile farther east, struck a large flow of gas, with some water, at this horizon. The Rainy Hills No. 1 well located still farther southeast along the Denhart structure in Section 34-19-10-W. 4th M. obtained a flow of 2,000 Mcf. in a similar sand at a depth of 2,931-2,948 feet, without any evidence of salt water content.

The possibilities of developing a commercial gas field in the basal Colorado sandstone are considered favorable, particularly in the vicinity of Anglo Steveville No. 1 well. The information which we have at hand indicates somewhat variable conditions as to sand development and character of accumulation at this horizon and it is very difficult to assess the economic possibilities. It is believed, however, that the chances of finding a large commercial gas accumulation in this formation present the most attractive possibilities in this respect within the entire Princess-Steveville area.

GAS IN CHERT BED

Anglo Steveville No. 2 well, in Lsd. 4 of Section 14-20-11-W. 4th encountered 3,000-5,000 Mcf. of gas accompanied by some oil and salt water at 3,259-3,269 feet in the Chert Bed. Casing was cemented at 3,259', but following a two weeks test the gas flow decreased and water incursion gradually increased.

GAS IN MADISON LIMESTONE

(2) At Rainy Hills No. 1 well in Section 34-19-10-4, gas in considerable quantity was encountered within the top 100 feet of the Madison limestone. After running casing, the initial production test yielded over 7,000 Mcf. per day with a slight naphtha content and as the test proceeded a small quantity of salt water appeared. Whether or not this gas accumulation constitutes an exploitable reserve, can be proved only by further development and testing.

PROSPECTIVE GAS AREAS

SOUTHERN PLAINS

A number of gas discoveries on the southern plains, significant not only because gas occurred with considerable volume and pressure, but also because of their proximity to the established pipe line system, are discussed briefly below. No attempt is made to estimate possible reserves represented, our information being insufficient for that purpose.

Pinhorn

(3) The Mayland Southern well, drilled in 1932 in Lsd. 13 of Section 4-1-9-W. 4th Meridian, encountered 4,250 Mcf. of dry gas in sands of the Blackleaf member of the Colorado shale, chiefly from the Bow Island sand at 1,880 feet. Gas was also encountered in the Madison limestone at 2,840-80

feet and at 2,925 feet. These horizons yielded 7,350 Mcf./ day accompanied by a little water. A second well drilled down dip one and one-quarter miles to the northeast in search of oil, proved to be 400 feet lower structurally and was a dry hole. The possibilities for development of a gas field by further drilling on the higher part of the structure seem fairly favorable, particularly in the Bow Island sand, which has proven such a prolific source of gas in southern Alberta.

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Pinhorn East

This is also known as the Black Butte structure. In 1943 McColl-Frontenac No. 6-8-1-8 was drilled 5½ miles east of the original Pinhorn discovery in Lsd.6 of Section 8-1-8-W.4th Meridian. This well encountered 5000 Mcf of gas in the so-called Ribbon sandstone at the base of the Cretaceous at a depth of 2,970-95 feet and 4000 Mcf. in the Ellis sand at 3,211 to 3,231 feet. An additional unmeasured flow was obtained in the Madison limestone at 3,282- 3,310 feet. A second well drilled 1¼ miles to the northeast and somewhat lower structurally, encountered only 1,000 Mcf. in the Ribbon sandstone at 2,971-89 feet, but 6,250 Mcf. in the Ellis sand at 3,203-3,213 feet. The bottom hole flowing pressure in the Ellis sand was 1300 pounds to the square inch. The possibility of developing a substantial gas reserve in the Ellis sand in this area appears to be quite promising.

Dead Horse Coulee

The sensational Rogers Imperial well in Lsd. 9 of Section 29-1-11-W.4th Meridian was drilled on this structure in 1927, yielding a total flow of 50,000 Mcf. a day from the basal Cretaceous sand, Ellis sand and the top of the Madison limestone at depths ranging from 2,530 to 2,700 feet. Two additional wells, one located one mile northwest and another one mile southeast, proved to be lower structurally and were dry holes. It is possible that a considerable gas accumulation may exist south of the discovery well along the structural "high". The Rogers Imperial well was produced from 1930 to 1939, the gas being exported to Montana, total production amounting to 1,300,000 Mcf. before the flow was exhausted.

Erickson Coulee

The Northwest Erickson Coulee No. 1 well in Lsd. 13 of Section 8-1-12-W.4th Meridian was completed in 1927 and encountered gas flows in the basal Cretaceous sand, the Ellis sand and the Madison limestone at depths ranging from 2,375 to 2,530 feet, the cumulative gas flow amounting to approximately 10,000 Mcf. per day. Recently two wells drilled on this structure, down dip from the original gas discovery, in search of oil, yielded negative results. Exploration south of the gas well along the higher part of the structure might possibly extend the gas area into a commercial field.

Eagle Butte

The Eagle Butte No.1 well located in Lsd. 9-31-7-4, W.4th was drilled in 1928 and encountered a flow of 20,000 Mcf. in the Bow Island sandstone at a depth of 3,340 feet. After blowing dry gas for a short period, water appeared and it is believed that the gas accumulation may have been quite local. However, this area is considered as favourable for further exploration since it is quite likely that the well may have penetrated the edge of an extensive gas accumulation holding commercial possibilities.

Taber.

Major Taber No. 1 well in Lsd. 12 of Section 9-9-17-W. 4th Meridian, drilled in 1944, struck a flow of 6,000 Mcf. of gas in the Taber sand at 3,256 feet. Recent drilling suggest that the accumulation of gas is likely to prove local, with edge-water closely associated under considerable hydrostatic pressure.

FOOTHILLS

Jumping Pound.

Shell 4-24-J well, located in Lsd. 4 of Section 24-25-5-W.5th Meridian, completed in December, 1944, encountered naphtha-bearing gas in the Madison (Rundle) limestone at 9740-9850 feet. Maximum flow measured was 13,500 Mcf. of gas, carrying with it 115 barrels of naphtha, per day. It is impossible to estimate, on the basis of this result, how extensive the field may be and what possible reserve of gas exists.

Q Mr. Webb, have you any other comments to make? If you have any other comments to make you are privileged to do so. I have no particular questions to ask.

A With regard to the Viking-Kinsella area where evidently Mr. Slipper's estimates and my own are at wide variance, I think it is obvious that he has included a larger area as proven or containing probable reserves, and part of the territory that I would consider as possibly good prospecting territory but not regarded as containing probable reserves. He has evidently included that in his estimate of 600 billion of reserve. There was one point there in connection with porosity, I believe Mr.Slipper gave the porosity, the estimated porosity of the Viking sand at Viking as 25%.

Q Was that not Kinsella?

MR. SLIPPER: No, Viking.

A THE WITNESS: And the porosity of the same sand at Kinsella is probably somewhat greater. That would seem to me to be rather high, as I indicate in my volumetric calculations for both of these fields. At Viking I used

15%, and Kinsella 20%. From what I know of porosities and sands, 25% is just about the maximum for any sand, whereas we know at Viking, for instance, that the sand is particularly fine grained, in some places rather argillaceous containing a good deal of cementing material. Undoubtedly it is somewhat better at Kinsella.

In Mr.Slipper's estimate of reserves he no doubt has had access and has had a lot of experience with pressure data, which may enable him to arrive at a close estimate of the reserves. Again, though, it seems to me that it comes down to a question of the area to be considered as proven, what are proven reserves and what are possible reserves. I think our experience in drilling to the South and Southwest of these gas fields in the last few years in search for oil has shown how local the sand conditions may be at this Viking sand horizon. I think that we should use a good deal of caution in extending the known area. My own basis for outlining the probable, I use probable in the sense of proven, the probable area at both Viking and Kinsella might be regarded as ultra conservative, but we have the evidence of variability in the gas sand, that is, development at the actual thickness of sand and porosities and the fact that at both of these fields marginal wells have been drilled, that is, one well in each field showing the tendency of the sand to pinch out, locally at least. We do not know how serious it is in each of these cases I refer to because drilling has not been carried beyond these two poor wells. As I have said, regionally we know that the sand disappears entirely to the Northeast. I do not just recall at the moment the distance from the Duluth Syndicate well Northeastward to the closest well where that sand is entirely

lacking, I think it is something like 10 or 15 miles.

Q MR. STEER: The Duluth Syndicate well and what well?

A The closest well to the Northeast at which the sand is entirely lacking. It was one of the Imperial wells up there to the Northeast towards the Vermilion area, so that we can cut off the Viking sand in its productive possibilities, I would say, within five miles Northeast of the Duluth Syndicate wells. To the Southeast from the Kinsella field we know that the sand becomes less productive. It is present in the Fabian area but relatively small flows are only yielded. As I indicated, the development of the sand Northward from Viking probably had limitations judging by the results in the old Talpy-Arnold well. I do not think there is anything else.

Q MR. CHAMBERS: Thanks, Mr.Webb, that is about all the questions I have.

THE CHAIRMAN: Mr. Steer?

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THE CHAIRMAN: Mr. Steer.

MR. STEER: I would like to have an opportunity of studying this report before cross-examining, sir.

THE CHAIRMAN: I rather anticipated that, Mr. Steer, and I quite understand it too.

MR. STEER: If we had had the report last night, I could have gone over it with Mr. Slipper and it would have been a different matter.

THE CHAIRMAN: Can you go ahead with Mr. Galloway's evidence now, Mr. McLaws?

MR. McLAWS: At any time.

THE CHAIRMAN: We will adjourn for 15 minutes and then we will take Mr. Galloway. How long do you want, Mr. Steer? Tomorrow morning?

MR. STEER: Oh yes, not any longer.

THE CHAIRMAN: And is that true of the rest of you?

MR. McDONALD: Yes, sir.

THE CHAIRMAN: You would want some time to consider this report of Mr. Webb's, Mr. McLaws?

MR. McLAWS: I might explain our position. We have no immediate interest in the supplying of gas at this time. As long as the war is on steel should not be used or cannot be used if it should, for pipelines where there is already a supply of gas. We are only appearing here because we think we should place before you at this time what information we have as to our own operations because they may enter into future consideration. So that I do not intend to take any part in cross-examining Mr. Webb.

(At this stage the Hearing was adjourned for 15 minutes.)

JOHN O. GALLOWAY, having been duly sworn, examined by Mr. McLaws, testified as follows:

Q Mr. Galloway, you are by profession an engineer?

A I am.

Q Would you state your qualifications?

A I am a graduate of the University of Oklahoma with the degree of Bachelor of Arts. I majored in geology and petroleum engineering. I also did a year of post-graduate work at the University of Colorado, majoring in geology. In 1924, I was employed by the Standard Oil Company of California as geologist and in 1928 I was appointed District Geologist for the district which included the Cadomin Hills oil field. I was there as resident geologist until August 1936, when I left and went into consulting work until April, 1938. In May, 1938, the Standard of California sent me to Canada as Land & Geological representative.

Q You are now Executive Vice-President of the California Standard Company?

A I am.

Q And that company is a subsidiary of the Standard of California carrying on operations in the Province of Alberta?

A It is.

Q Your duties here up to date have been in endeavouring to discover petroleum?

A That is right.

Q And in carrying on your search for petroleum you have developed the Princess gas field?

A That is correct.

Q Princess is roughly about 60 miles to the north of Bow Island and of the pipeline serving the gas consumers in Southern

Alberta.

A That is correct.

Q And in drilling wells in the Princess area for your company you uncovered stratas bearing or producing natural gas.

A That is correct.

Q The first was the Basal Colorado?

A Yes.

Q At what depth?

A At approximately 2750.

Q And the next was the Sunburst.

A The so-called Sunburst zone which is in the lower portion of the Cretaceous sands and that was penetrated at Princess at about 3165 feet.

Q You made tests of the gas in that zone?

A We did, in every well we drilled.

Q What did you find as a result of your tests?

A In the first seven wells drilled and I believe those are the only ones in which we tested the Sunburst zone, with two-thirds back pressure the wells in each instance made 10 million to 12 million cubic feet of gas per day.

Q What pressure was the gas?

A The pressure is estimated between 1500 and 1575 pounds.

Q You had your engineers make estimates based on geological work you have done there as to the amount of gas available in this structure?

A That is correct.

Q That might be considered as a proven area there?

A Yes. We primarily were interested in the discovery of petroleum but we thought it advisable to determine the amount of gas present as well. Does that answer your question?

Q Go ahead. What did you find?

A The initial test made at the so-called Princess-C.P.R. No. 1 well, we drilled through and tested the Sunburst zone and then took the well on down to the top . . . . .

Q Before we go on down, Mr. Galloway, I suggest you tell us what was the result of your computations as to the amount of gas that you had available in that structure in the Sunburst zone.

A After drilling seven wells on this structure, I had the engineers in our organization compute the amount of gas which should be present in that zone. I should say this that in making these computations it depends largely on whether you are very conservative or very optimistic.

Q That is you might have a wide variation?

A You might have a wide variation.

Q We had an example of that while we have been sitting here, I think.

A Now these computations have been given and these results have been given to me. Of course I used, from a practical point of view, the data which appeared to be the conservative picture, from my point of view. In the computations made by the engineers in our organization, we computed the conservative picture with a conservative result of 72 billion cubic feet and an optimistic result of 138 billion. This would be the amount of gas which would be available down to a pressure of 100 pounds at the well head. From my own point of view and to assist me in carrying on operations in that area, I picked the figure of 100 billion cubic feet of gas.

Q Which in your opinion was a reasonable computation?

A It is.

Q Then you continued your wells to a lower depth?

A Yes. The initial well particularly.

Q Even down to the Jefferson-Dolomite.

A In the initial well, the C.P.R. No. 1, we took that well to the Jefferson and through the Jefferson Dolomite.

Q And oil is being produced from that zone, is it not?

A At the present time we have a well which is producing from the upper wall of the Jefferson Dolomite.

Q And that has been produced by gas pressure producing gas with oil.

A Yes. I believe it is producing by reason of gas included in the oil

Q And that is at a depth of about 3900 feet?

A I believe the depth of the hole is 3983.

Q Then you carried one well on down to the lower Devonian 4800 feet?

A Yes. We got into mechanical difficulties in the initial well because we penetrated strata that we did not expect. So that it was impossible to test the well by using the usual drill stem tester after we got to a depth of 3850 feet. So that we drilled the well then from 3850 feet with occasional cores down to a depth of 6156 feet.

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Q And you struck a strata with gas under heavy pressure?

A That is correct. At 5,258 feet the contractor had to make some repairs to his drilling rig so that he was shut down for, he expected to be shut down, he had to make repairs so that he expected to be shut down for about three days and on about the second day the well blew out of control, eventually it blew down the derrick and injured some of the workmen.

Q And you are not able to make any estimate,any reliable estimate of how much gas you have at that well?

A Well I can estimate, or we have estimated rather the amount of gas which the well was making at the time it blew out of control or was blowing out of control. We had nine inch casing cemented at 3,240 feet, at a point which was about four feet below the top of the Paleozoic limestone, I believe it has been referred to here as the Madison, so that the well was actually making gas from theinterval between 3,240 and 5,258. We made a measurement of that flow at one time using a Pitot Tube and while I cannot tell you exactly how accurate that might be, the result we obtained was 60 million cubic feet per day.

Q That the well was making?

A That the well was making.

Q At what pressure?

A When we finally killed the well and shut it in the pressure was 1975 pounds. I might say that if, there, if we used that pressure and assumed that it will be the same as the theoretical pressure in any zone, the depth at which this gas was flowing should be around 4550 feet. We have not,

since that time we have not tested that zone or that well.

Q So that your estimate of 100 million cubic feet available was from the Sunburst zone?

A My estimate was 100 billion feet, and it was from the Sunburst Zone.

Q What class of gas is that, is it suitable for use for domestic purposes?

A It is gas of good quality. Its B.T.value is 1057 approximately.

Q And does it need any treatment for use for domestic purposes?

A No, except for to extract a slight amount or small amount of naphtha.

Q So that taking you to, what can you say, Mr. Galloway, as to, you have been doing geological work all over Southern Alberta, have you not?

A We are still in the process of doing that. We have been working over most of the plains of Alberta at one time or another. We have not completed our work by any means.

Q You are still working at it?

A That is right.

Q Can you form any opinion from that as, - first, before I ask that, you have already said that your object up here is to find petroleum?

A That is correct.

Q And since the discovery of this gas field at Princess, your future drilling or your subsequent drilling has been with the object of not developing gas but of discovering petroleum?

A That is right.

Q Developing petroleum?

A That is right.

Q But your work has given you some information as to the probabilities of additional gas fields in that immediate district or that general district?

A Are you referring to the Princess?

Q The Princess district and the general district?

A Yes. It is my personal opinion that that area will be one of the great gas producing areas in Western Canada.

Q Do you believe it will ultimately be able to supply the entire requirements of this gas distributing system for Southern Alberta?

A I do.

Q Are the wells expensive to drill?

A It depends upon the depth of course but to drill wells to the Sunburst Zone and to complete them will cost about $35,000.

Q So that the production cost is reasonable?

A The production cost is very reasonable.

Q Can you say whether, if pipe was available and you could supply gas, could you supply gas into this Southern Alberta system at a price, comparable to what is now paid at Turner Valley?

MR. CHAMBERS: If it pleases the Board, I do suggest that on some of these matters, this Witness should not be led. I know my learned friend has been leading up to the present time but I do not think he should continue.

MR. MCCLAWS: I thought I could give the evidence myself.

THE CHAIRMAN: No, I am not going to be too strict on

the rules, Mr. Chambers. Go ahead, Mr. McLaws.

Q MR. McLAWS: Will you answer that?

A If the Reporter will read the question.

(Reporter reading) Q "Can you say whether, if pipe was available and you could supply gas, could you supply gas into this Southern Alberta system at a price comparable to what is now paid at Turner Valley."

Q MR. McLAWS: Which I understand is 7½ cents?

THE CHAIRMAN: 7¾ cents.

Q MR. McLAWS : Assuming of course a reasonable market, a reasonable market for a reasonable amount of gas, not some small amount?

A It would depend on the amount of gas which could be sold by the California Standard Company. If the Company could be assured of an out-let for at least 15 million cubic feet per day it could be sold at Bow Island for that price.

Q DR. BOOMER: Scrubbed gas?

A Yes, ready for use.

Q MR.McLAWS: This gas does not need to be scrubbed?

A It does not.

Q DR. BOOMER: Sulphur free?

A Sulphur free.

Q MR. MCDONALD: How many feet did you say', 15 million or 50 million, which did you say?

A I took a figure of 15 million.

Q On an average?

A I may say this, from a practical point of view, I would not want my offer to be rejected if they were talking of a little less figure.

MR. McLAWS: I think that is all the information which might be useful.

THE CHAIRMAN: Mr. Chambers?

MR. CHAMBERS: I think probably I would like to ask this witness some questions but I would like an opportunity first of discussing some of these matters with my associates.

THE CHAIRMAN: Mr. Steer, are you in the same position?

MR. STEER: No, I am not in that position I think at this time. There are only two or three things I would like to clear up.

CROSS EXAMINATION BY MR. STEER:

Q Mr. Galloway, you spoke of production from the Devonian and Dolomite, now I rather gathered you got some oil production there?

A Yes, there is also gas production available.

Q And you did not give us any idea of the amount, at least I think you did not give us any idea of the amount of gas which could be obtained from that horizon?

MR. McLAWS: No, we did not give anything except the Sunburst because no test has been made.

MR. STEER: Are you able roughly to give us an idea of what the gas productivity of that horizon would be?

A Any estimate I would give you would be a guess based on the immediate data. We know that gas is present. If we take the top portion of the Jefferson Dolomite and consider that alone in all of the wells which have been drilled at Princess on structure, gas has been present in that zone. The most that we have found in one location has been approximately 6 million cubic feet per day flowing through a very restricted opening.

Q Through a very restricted opening?

A Correct.

Q That would mean something less than perhaps the opening with which you tested the Sunburst, would your opening be more restricted than that opening?

A Yes, the opening which I had in mind when I made this statement at the last was an opening I believe of three eighths of an inch in the bottom of a drill stem tester. You see that would be in the bottom of the hole and would be, I believe the test extended over an hour. Just what the well might make under proper conditions I cannot say. It might be that that test would be fairly accurate but as I said I cannot say.

Q Yes. Well then what you would say perhaps is that from this horizon you might get as much as three-fifths of what you would get from the Sunburst Horizon?

A I have not thought of it in that manner. I have thought of it in another way. It is my opinion that eventually in this general area several times one hundred billion cubic feet of gas will be obtained.

Q Several times?

A Several times one hundred million cubic feet of gas will be obtained from other zones and from the Sunburst Zone in other locations.

Q And included in your mental picture when you gave your answer to Mr. McLaws, you included this production from the lower zone when the well got out of control, did you?

A No, when I answered Mr. McLaws' question I had in mind the production only from the Sunburst.

Q I see?

A And I might say if such a market were available we would drill additional wells in order to produce 15 million cubic feet of gas per day.

Q Yes, so that what you would say then is that from the Sunburst Horizons under the control of your Company, several times one hundred billion cubic feet of gas would be available for the Calgary market, given proper marketing conditions?

A No, I did not say that but I will say that it is my opinion that on this particular Princess structure, several times one hundred billion cubic feet of gas can eventually be obtained from horizons other than the Sunburst Zone.

Q Oh yes?

A Now the statement I made previous to that was one in which I included not only Sunburst but the surrounding general area.

Q I see. Now when you are talking about these quantities you are talking about gas that is available down to and can be produced down to 100 pounds pressure?

A That is correct.

Q That is correct?

A And I might say further in order that it may be clear that in making that statement I have in mind drilling several wells so that I may produce those wells under good pressure and in any event there is no question in my mind but that I can produce those wells down to approximately 100 pounds well head pressure.

MR. STEER: Yes, thank you.

MR. CHAMBERS: If the Board pleases it may save some time if I should give to this Witness an indication of certain questions which I know I will have to ask him. As I understand it, the Witness has indicatedin his evidence that he is prepared to supply 15 million cubic feet per day to the Calgary market at the Turner Valley price. Now

frankly I have in mind asking him some questions as to how he arrives at that estimate and I think that statement having been made, we are entitled to some breakdown.

THE CHAIRMAN: I will give you that opportunity, Mr. Chambers.

MR. CHAMBERS: Well I am raising it now but I would like to defer my examination until tomorrow and I may say I feel that time will be saved.

THE CHAIRMAN: Mr. McDonald?

MR. MCDONALD: Might I defer my examination also until tomorrow.

THE CHAIRMAN: I have something to say which may make you reserve your cross-examination to sometime later than tomorrow.

Have you anything, Mr. Harvie.

MR. HARVIE: At the moment I might have something.

CROSS EXAMINATION BY MR. HARVIE

Q And that is, Mr. Galloway, do I understand from you that this gas is free gas, that it does not need scrubbing to make it available for market?

A That is the statement which I made.

Q And you also said it has some gasoline content?

A That is correct

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Q MR. HARVIE: Is it in sufficient quantities to make it necessary to treat it before it is in condition to use in the Calgary market?

A Well I had in mind, Mr. Harvie, that we would extract that before placing the dry gas into the line.

Q That will be an operation of your Company the same as -

A That is correct.

THE CHAIRMAN: Anything further?

CROSS-EXAMINED BY MR. BLANCHARD:

Q Mr. Galloway, does your Company feel that it has now sufficient information about reserves in this field to justify it on the information you now have in expending money to drill wells, lay pipe lines to Bow Island, that is if the Gas Companies are prepared to purchase gas from you now. If pipe was available, would you consider you were justified in making the very heavy expenditures in drilling new wells, installing pipe lines and putting in such other installations as are necessary on your present information or would you consider you would have to make a very much more lengthy examination of the field?

A It is pretty difficult to answer your question without stating that I must be given other factors. If I were to be assured of a market of 15 million cubic feet a day then I would take the contract and I would then conduct a search as economically as possible in the Princess area for gas. I have not done so yet, but I might say another thing that I would expect to be given the sole right to take gas from that area wherever it might be found. Under those conditions the answer is, yes.

Q Subject to your assuring yourself that there is sufficient gas in that area to furnish gas, say up to one billion cubic feet?

A I am sorry. I probably did not make myself clear. I think my statement indicated that I thought there was sufficient gas.

Q Yes, I know, but are you assured of it to the extent of feeling justified in spending a great deal of money?

A Well it depends upon the amount of expenditure, Mr. Blanchard. I have been in the oil business all of my life and I have not yet seen a sure thing and I am used to taking chances and if my judgment says that is the way to go, I generally go that way, and my judgment in this case says go.

Q What area are you taking into account in computing the one hundred billion cubic feet?

A An area on the Princess anticline which should be not less than 5900 acres.

Q And what area is covered by these wells that you now have drilled. I mean taking the perimeter of the wells?

A I have two wells, or rather I should say the California Standard Company has two wells at the north end of this area and I have forgotten how many, but three or four at the south end of the area. The California Standard Company has geological maps based on that information which has been obtained by the drilling of these wells. In addition to the wells owned by the California Standard there are wells drilled outside the area. There are wells which have been drilled outside the area by other Companies and that information is available to the California Standard Company.

Q But you are taking an area of about 5900 acres which you considered to be proven?

A That is correct.

Q And within that area you compute you have one hundred billion cubic feet?

A That is correct.

Q From the Sunburst only?

A That is correct. I might say -

Q Plus whatever may be found in the lower horizons?

A Pardon?

Q Plus whatever may be found in the lower horizons?

A Well I have not taken the other horizon into consideration. I might say this, Mr. Blanchard, if I may in order that we may have our minds together, I have taken a thickness of 35 feet for the Sunburst zone. I have taken a porosity of 16% for the Sunburst zone.

Q Yes I was going to ask you how these reserves were computed.

A The volumetric method.

Q And your earliest well, when was that drilled?

A The Princess C. P. R. No. 1 well.

Q The first one that you are using in your volumetric method, the earliest pressure that you got?

A Oh I am sorry, I misunderstood you. We have drilled six wells. We drilled seven wells in the area and I believe in all of those we have obtained pressure in the zone, the Sunburst zone and as I stated previously that pressure I believe varies between 1500 and 1575 pounds per square inch.

Q That was the initial pressure?

A That is the pressure of the zone.

Q And that is the present pressure?

A That is the present pressure of the zone.

Q Were these wells permitted to stay open flow for any length of time in order to test them?

A We are producing two of them, C. P. R. No. 1 and Princess C. P. R. No. 2 in order to use the gas for fuel in drilling wells in the area. We have had those wells on production for

a number of years.

Q For how long?

A For a number of years off and on during each year. At the present time we now have -

Q And do you know the volume of gas that has been produced altogether?

A Yes, it is measured and those figures, while not in my possession at the moment, I believe they are available and given to the Conservation Board, but the amount of gas produced is not large since it has been used for the drilling of wells.

Q What I had in mind was this, that the Rogers Imperial well which was mentioned by Mr. Webb, it had an initial flow of fifty million cubic feet a day and that well exhausted itself in the course of two or three years. Is that correct. Well it produced one billion three hundred million cubic feet of gas, I thought that was what he said. Yes. Over a period of nine years and then the flow was exhausted. One billion three hundred million cubic feet of gas. That apparently exhausted that reserve there, a producing well. I am trying to get at whether or not the same thing might not apply to Princess. Have you had a long enough period over which to base your computations of gas reserves to be able to say assuredly, with any assurance, the quantity of gas?

A It is a matter of -

MR. McLAWS: Do you mean a sufficiently long period of production?

MR. BLANCHARD: Yes. He has already said the amount of gas reserves.

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Q Do you think the wells have been operated for long enough periods to give you some basis for estimating your resrves?

A My answer is it is difficult for me to answer that question because before I would attempt to answer I would have to review, if such is available, the data in regard to the producing practice followed by the operators in producing this well, and I just will have to, I do not know anything about their producing practice. They may have ruined it, they may have lost it, they may have done most anything. A while ago/I was testifying as to the producing practice at Princess, I was careful to say that we could build a large number of wells out there and produce those wells under proper producing practice. I know nothing about this well you are referring to. Its practice may have been excellent or it may have been terrible.

Q All right. The other part of my question was this, as to whether you considered that you have been producing wells on the Princess structure for sufficient length of time to enable you to have a sound basis for computation of the reserves of that 5900 acres?

A I think so, Mr. Blanchard. I said before that conservative engineers have computed 72 billion, and some of our more optimistic engineers 138 billion. And I think that 138 billion is a fair estimate.

Q By the way, are those computations available?

A I do not have them, but they are computations which I am sure any engineer can make. There is nothing mysterious about them.

Q No. No. No, I do not question for a moment that engineers made it, but it is only to ascertain the basis how those

reserves were arrived at, what figures were taken as to the pressures, productions and so forth?

A Yes. I will give you those figures here and any engineer may compute them.

Q That is what I want.

A We took the figure of 1545 pounds pressure, we took 5888 acres, we took a porosity of 16%, we assumed a connate water content of 20%, and I believe then a correction was made by deviation and a correction for temperature. With those factors,I think, I am certain any engineer may make those computations.

Q DR.BOOMER: What about the thickness of the sand?

A The thickness of the sand was 35 feet.

Q MR.BLANCHARD: What about the danger of the water intrusion, could you give us any outline on that?

A Yes, Mr.Blanchard, I think the danger of water intrusion is very great unless the wells are produced under good operating practice.

Q That is, you would have to produce them at say 20% of their capacity or something of that kind?

A I had in mind that we might produce at 10%.

Q At 10%?

A Yes.

Q And that way there might not be any water?

A We might vary that from time to time as we watch the pressures in the field, and watch the production rate.

Q All right, thank you.

THE CHAIRMAN: I think that is all we want from you today, Mr. Galloway.

DR. BOOMER: I have a couple of questions.

Q I was not quite clear. Mr.Galloway, about your statement on the price that you would sell the gas at. You say you would take the Turner Valley price at Bow Island?

A At Bow Island.

Q At Bow Island?

A Yes, but that price of course would be dependent upon the volume.

Q For this 15 million?

A I would not want any less than 15 million.

Q Have you considered the cost of moving your gas from Bow Island up to say Okotoks or Calgary?

A No, I had in mind that it would be sold at Bow Island, and we would have no further interest in it.

Q That is all I have.

THE CHAIRMAN: Gentlemen, you remember that yesterday we were dealing with present and estimated future market demand, and all the estimates given were predicated upon the Nitrogen plant closing down at the end of next year. Mr. Donald, of the Department of Munitions and Supply is in the city and he desires to give some evidence on that point. We had hoped to keep him here until next Monday to give his evidence then, but this morning he had a long distance telephone call as a result of which he cannot stay until next Monday. He tells us that his evidence will be very short, he said fifteen minutes, so I will allow him an hour, and in order to accommodate Mr.Donald, we are going to have his evidence first thing tomorrow, at half past nine, and Mr.Galloway's cross-examination will follow on Mr. Donald's evidence.

MR. McLAWS: At ten?

THE CHAIRMAN: I hope. That is going to disrupt our schedule a little. Then, of course, there is Mr. Webb.

MR. STEER: Well, I can undertake that that will not be very long.

THE CHAIRMAN: Yes. I think we will take Mr. Galloway after Mr.Donald, and then Mr. Webb. And that leaves us decide whether we are going to start another item on the Agenda at this time of the day. We are quite willing to do so if you wish, but whether we should start another item of the Agenda in the middle of this particular one, perhaps, is questionable.

MR. CHAMBERS: Mr. Stevens-Guille is available to deal with the sharing position.

THE CHAIRMAN: We cannot finish it. We have two items unfinished now, and it might be more convenient to finish them. Mr. McDonald,you are anxious to get something in on alternative fuels before we start on the rest of it. I was thinking of that. How long will that take, the evidence that you want to lead, Mr. McDonald?

MR. McDONALD: It might take two hours. I do not know if any other submissions are available or not.

THE CHAIRMAN: Well again there is no use in starting that and breaking off in the middle, and starting on another thing tomorrow.

MR. CHAMBERS: No chance of Mr.Donald being available now?

THE CHAIRMAN: No. What Mr.Donald is doing at the moment is preparing a submission which it is proposed will be given to each one of you in the morning. We have asked him to do that and he has gone to prepare it.

What do you wantto do, gentlemen? Start with Mr. McDonald alternative fuels today?

MR. CHAMBERS : No.

THE CHAIRMAN: I think not.

MR. McLAWS: Might I suggest, so that we will not come back another time, when Mr. Chambers is cross-examining Mr.Galloway, if he wishes to have him bring anything or have anything here, he had better tell him now.

MR. CHAMBERS: What I had in mind was the question of the cost. I think we should have that available tomorrow so that we can ask him some questions about that.

THE CHAIRMAN: Mr. Galloway, Mr. Chambers will probably want to examine you tomorrow with a view of getting a break-down of your 7⅞¢. Perhaps you could have something for him along those lines?

MR. GALLOWAY: I will try to have it.

MR. McLAWS: What do you expect Mr.Galloway to disclose, what it is going to cost him?

THE CHAIRMAN: Well, the price of a pipeline to Bow Island, the gas is going to be f.o.b. Bow Island, so that he has the well head price and the transportation charge to Bow Island.

MR. McLAWS: We have gone into those.

THE CHAIRMAN: Just a minute, please, gentlemen.

MR. McLAWS: We have gone into this enough so that Mr.Galloway is able to say he is prepared to take a contract. There are a lot of contingencies in those. If it is good enough he is prepared to take a contract. That is his evidence. His company is responsible. They are able to carry it out. But to start in and disclose how much he is going to make on this, how much he hopes to

make, or what margin he has got and everything about it, I do not see that that has anything to do with it.

THE CHAIRMAN: Although,Mr. McLaws, he has opened the door for cross-examination on that point, I think

MR. McLAWS: Yes, he may have.

THE CHAIRMAN: And it is possible.....

MR. McLAWS: It would have to be pretty sketchy.

THE CHAIRMAN: That is what I would imagine.

MR. McLAWS: I mean we are not going to put in any estimates. As far as I can understand this peoceeding here, suppose some time in the future the Gas Company went to take gas from there, and no other supply came up in the meantime, I presume then the matter of price would be fixed by your Board, is that not right?

THE CHAIRMAN: Yes.

MR. McLAWS: And in that case we would have to submit to you all these figures you are asking for on conditions as they exist today.

THE CHAIRMAN: Mr. Galloway's estimate, or rather his willingness to sell at $7\frac{3}{4}$ is predicated upon a daily market of 12 million cubic feet.

MR.McLAWS: 15 million cubic feet average.

THE CHAIRMAN: 15 million cubic feet average?

MR. McLaws: Yes.

THE CHAIRMAN: And I suppose it is only on that point that he can be submitted to cross-examination?

MR. McLAWS: Yes.

THE CHAirman: And I would imagine his replies would be sketchy?

MR. McLAWS: Yes, his replies would be sketchy.

You cannot expect us to put in today figures that we would put in if a contract was to be submitted to you for approval or something like that.

THE CHAIRMAN: Or if you were going to discuss a rate base with us tomorrow.

MR. McLAWS: Yes. There is no use of asking about that.

THE CHAIRMAN: Mr.Galloway will just have to do what he can, Mr. McLaws, on that, go as far as he is able to. So that we will have Mr.Donald the first thing in the morning, and then Mr.Galloway and then Mr.Webb. Adjourn to 9.30.

(The Hearing was then adjourned to 9.30 A.M., April 5th, 1945.)